FORUM

ARS's Animal Breeding Work

In the 18th century, a British sheep farmer named Robert Bakewell set out to improve his flocks by controlling their mating activities. At that time, farmers customarily raised male and female livestock together and allowed them to mate randomly, but Bakewell wanted more control over his sheep. So he separated the rams from the ewes and selected those with the most desirable traits for breeding.

Bakewell embarked on this first-known attempt at selective breeding nearly 100 years before Gregor Mendel launched the modern genetic movement by demonstrating that pea plants pass on traits to their offspring.

By the time the U.S. Department of Agriculture was created in 1862, the practice of improving livestock through selective breeding was about 100 years old. USDA scientists may not have invented animal breeding, but they've made many important contributions to the practice.

Animal genetics research from the Agricultural Research Service has contributed to significant improvements in production efficiency, quality, cost, and safety of animal products. Through decades of research, our scientists have honed their data-collection and data-evaluation techniques and contributed to our understanding of animal genetics. And they've established important breeding lines, such as Line 1 Hereford cattle, which have given rise to generations of high-quality livestock.

ARS research has also contributed to improved technology and methodology, such as innovations in sheep breeding (page 6). Our scientists have developed new tools and techniques for identifying desirable traits with greater speed and accuracy. They've also developed methods for evaluating the genetic merit and fertility of potential parent animals.

Bakewell and his contemporaries relied on visual assessments to estimate the fitness of potential parent animals. Today, many producers still use visual appraisals, but they also rely on more scientific measurements for traits such as milk production, birth weight, and muscling. All this information can be used to calculate a figure that predicts the average performance of that animal's offspring—called "Expected Progeny Difference" for beef cattle or "Predicted Transmitting Ability" for dairy cattle. The accuracy and speed of these calculations has improved greatly in recent years, thanks to ARS-developed DNA tests.

ARS scientists have also contributed to genome-sequencing maps for cattle, swine, sheep, poultry, and fish and have developed tools to help producers take advantage of available genomic information.

The Illumina Bovine SNP50 BeadChip, described on page 4, is one such tool. The BeadChip is a glass slide containing thousands of DNA markers, which scientists can use to improve their understanding of economically important traits. To date, more than 40,000 animals from at least 10 distinct populations have been genotyped using the BeadChip. Tools like this will become increasingly important as genomic research assumes a more prominent role in promoting the quality and profitability of U.S. animal agriculture.

ARS scientists have also developed tools to calculate the genetic merit of dairy cattle. They maintain a vast database of information on important genetic traits, such as disease resistance and longevity. The database represents nearly half a century of industry-wide testing and data collection and is used by thousands of industry professionals around the world.

Our understanding of animal genetics improves daily and with it our ability to identify and understand how genes relate to significant traits. Modern animal breeders have more tools and information than Bakewell could have imagined, but our objective is still the same: to improve the quality of livestock, poultry, and fish by selecting the best available parents to produce the next generation.

In 2007, the USDA Animal Genomics Strategic Planning Task Force—a group comprising members of ARS, USDA's Cooperative State Research, Education, and Extension Service, and university collaborators—developed the "Blueprint for USDA Efforts in Agricultural Animal Genomics." It identifies three major areas of focus for genomic research, education, and extension efforts: outreach, discovery, and infrastructure.

Making genomic technology and information available to producers is essential to the success of U.S. animal-breeding efforts. To that end, USDA's outreach goals include developing and transferring technology to assist producers in tasks such as using genome-based data to predict genetic merit of individual animals and developing precision management systems to promote animal production and health.

Discovery-science goals involve expanding our understanding of how specific genes influence important characteristics. This includes identifying agriculturally significant genes, such as those that regulate disease resistance, feed efficiency, and product quality, as well as improving our understanding of how traits are influenced by animal and microbial genomes and the environment.

These goals cannot be advanced without the support of a strong infrastructure. Our plan for the future must also include efforts to promote genomic research, conserve genetic resources, establish and maintain genomic databases, and educate the public about the importance of animal genomics.

All these objectives reflect our ongoing commitment to promoting the growth and significance of animal genetics. For years, ARS scientists have made major contributions to the field, and I'm sure we'll continue to do so, whatever the future holds.

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